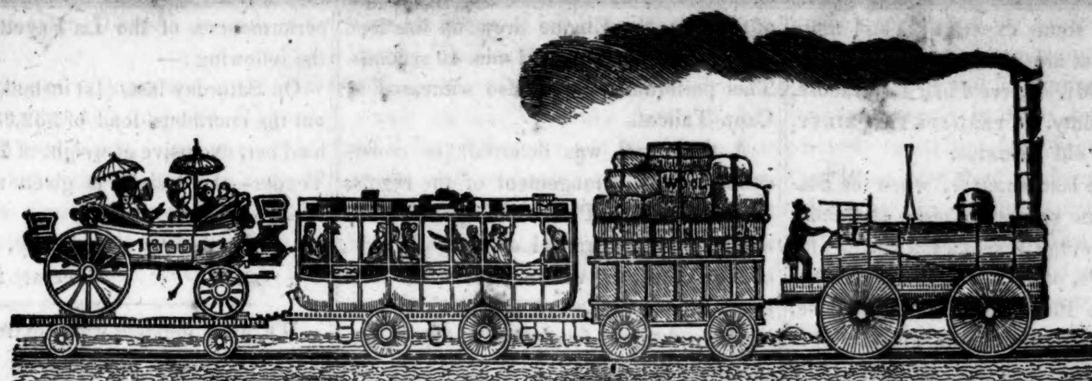

AMERICAN RAILROAD JOURNAL,

AND ADVOCATE OF INTERNAL IMPROVEMENTS.

PUBLISHED WEEKLY, AT NO. 30 WALL STREET, NEW-YORK, AT FIVE DOLLARS PER ANNUM, PAYABLE IN ADVANCE

D. K MINOR, and GEORGE C. SCHAEFFER, } EDITORS AND PRORIETORS.] SATURDAY, APRIL 8, 1837. [VOLUME VI.—No. 14.

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AMERICAN RAILROAD JOURNAL.

NEW-YORK, APRIL 8, 1837.

REMOVAL.—The Office of the RAILROAD JOURNAL, NEW-YORK FARMER, and MECHANIC'S MAGAZINE, is removed to No. 30 WALL-STREET, *basement story*, one door from William street, and *opposite the Bank of America*.

☞ It will not do, these hard times for money, to be too modest. The *Paper Maker* must be paid, the *Engraver*, the *Ink Maker*, and the *Printer* must be paid,—then why not Pay the Publishers and the Editors the *current year* and all *arrearages* for the Journal? *It must be done.*—PLEASE REMIT BY MAIL.

NEW-YORK AND ALBANY RAILROAD.—We are pleased to find that the friends of this work are still resolved to push the work on—and we ask the attention of our readers to the following notice for opening the Books for the purpose of obtaining subscribing to the balance of the stock. The city of New York has a deep interest in the early completion of this road—and upon the citizens of NEW YORK we call for prompt and efficient aid to build the Road.

NEW-YORK AND ALBANY RAILROAD.

NOTICE.—The books will be open for subscribers to the capital stock of the New-York and Albany Railroad Company, on the 25th, 26th and 27th days of April, from 10 A. M. to 2 P. M. on each day, at the following places:

At the office of the New-York and Harlem Railroad, No. 18 Wall street, New-York.

At the Mechanics' and Farmers' Bank, Albany.

At the Farmers' Bank, Troy.

Also, at such places as the Commissioners, residing in the counties of Westchester, Putnam and Dutchess, may appoint at the times herein specified.

On Monday, 8th May,	in Eastchester,
Tuesday, the 9th,	in White Plains,
Wednesday, 10th,	in Bedford,
Thursday, 11th,	in New Castle,
Friday, 12th,	in South East,
Saturday, 13th,	in Pateison,
Monday, 15th,	in Rawlings,
Tuesday, 16th,	in Dover,
Wednesday, 17th,	on Dover Plains,
Thursday, 18th,	in Armenia.

COMMISSIONERS.

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Jeremiah Anderson.

Shares $100 each, $5 to be paid at the time of subscribing. 14-3t

The following letter from William Norris, Esq., of Philadelphia, will be read with much interest by those who have read the account of the performance of his Engines:

For the Railroad Journal.

PHILADELPHIA, April 3d, 1837.

Messrs. MINOR & SCHAEFFER—

Gentlemen,—I received in due time your Railroad Journal, of March 11, containing a letter from A. G. Steere, Esq., of the New-York and Erie Railroad—and until this moment, press of business and unavoidable absence from home for the last week, have prevented my replying to the same.

To Mr. Steere's remarks, I reply, that, however wonderful such performances may seem to him, they are nevertheless all *substantially true*, and can be authenticated by the affidavits of scientific men, of the first eminence for talents and integrity.

Mr. Steere has based his calculations on previous theories, and seems determined to adhere to them, without admitting a probability of a change as science advances. He must then believe that Pambour has firmly established a Theorem forever, and that all the results of scientific experiments, from this date, as regards traction, friction, &c. &c., must be (to be true) in accordance with the formula so laid down. This is preposterous.

I am well aware, that the performances of my Engines, in giving results 50 per cent. better than any other, have created surprise, and in some instances doubt, but I can prove by disinterested persons of *well known* integrity, the facts of every performance, as detailed in my Circular, and I can appeal to yourselves, (Messrs. Minor & Schaeffer,) and also to 51 other gentlemen, as witnesses of the experiment of 19th July last. There was no mistake, no deception there.

In the course of this communication, I

shall record some experiments still more wonderful, that are also FACTS, and which will stagger Mr. Steere's belief still more, in the possibility, or PERHAPS PROPRIETY, of abolishing old Theories.

During the last summer, when the Stationary Engine was out of order and under repair, the George Washington Engine, for about 27 days, performed all the duties required on the Plane—and in one instance, for 5 days in succession, the mode of operation was thus, viz:—At the foot of the Plane, two cars would be attached to the Engine, which, with the Tender, seldom weighed less than 26,000 lbs. This load was then dragged to the summit in from 2 to 3 minutes. The cars were then detached, and the Engine secured to the rope, while at the foot and on the other track, 5 or 6 cars were likewise attached to the rope—the Engine would then be put in operation, descending the Plane, and dragging up by the rope, the cars so attached. The greatest weight dragged up in this way was 47,450 lbs.

Another of my Engines, the "Benjamin Franklin," has been, during the winter and spring, also performing the duties required of the Stationary Engine.

On the 16th ultimo, I put on the road two new Locomotives, built for the State of Pennsylvania, viz.—The "James Madison" and "La Fayette," both these Engines ascended the Plane with loads. On the afternoon of the same day, the La Fayette dragged up the Plane 38,000 lbs.—When about half way up, from 50 to 60 persons, from the crowd that had stationed themselves at that point to witness the experiment, jumped on the cars, and for a moment impeded her progress, (the wheels slipping,) but as soon as she was relieved of this extra load, she ascended to the top, and immediately descended with the two cars, stopping at pleasure in the descent. In consequence of the late hour, no further trial was made that afternoon. This performance was witnessed by 200 gentlemen, many of Science, amongst whom was Capt. Tallcot, of the New-York and Erie Railroad.

On the 18th another trial was contemplated, and for this purpose, two cars were loaded with Pig Metal and weighed, but on arrival at the foot of the Plane, a drizzling rain commenced, and soon formed a slimy coat on the rails—which were then in the worst possible condition. The two loaded cars were detached and the Engine sent up the Plane with the Tender, the weight of which loaded, was upwards of 10,000 lbs., and notwithstanding the bad condition of the rails, the Engine drew up this load in the very short space of 1 min. 40 seconds. This performance was also witnessed by Capt. Tallcot.

A third trial was deferred (in consequence of the derangement of the regular business on the Plane during the experiments) until the arrrival of Judge Wright, of New-York, at whose request the foregoing experiments were projected, he having been detained from them unexpectedly. A letter was received from the Judge last week, during my absence, informing of his arrival at, and departure from Philadelphia, but stating his intention of remaining in Philadelphia on his return, for the purpose of witnessing the experiments—and it would give me great pleasure to have Mr. Steere's company at the same time, to prove to him that old Theories MAY be abolished. When this trial takes place, Judge Wright shall superintend the weighing of the Engine, Tender, and load—shall take the measurements of the safety valve and lever, to ascertain the pressure—shall leave the whole matter under his absolute control, and when the result is published, I hope Mr. Steere will then admit that there is something *new under the* sun.

The La Fayette is performing daily on the Columbia Railway, and any persons can, at any time, see for themselves, the immense powers of this Engine. She drags with ease 25 loaded cars, over abrupt curves and high grades, and on a rise of 52 feet per mile, with the actual weight of 241,275 lbs. (taken from the Weigh Masters' Books) attached to her, she has come to a dead stand, and started again without the least difficulty from a state of rest. On Friday last, March 31st, this Engine brought in attached to her, the unprecedented and enormous load of 45 cars, 25 of which were loaded, and this load she carried over the grade of 52 feet rise per mile, without any difficulty, not a single instant's delay, but steadily at the rate of nearly nine miles per hour. Let unbelievers come and see for themselves.

The dimensions of La Fayette are as follows:—

Whole weight	18,725 lbs.	Including water and fuel while in operation on the road.
Weight on drivers	11,375 "	

Diam. of Cylinders, $10\frac{1}{2}$ inches,
Length of Stroke, 18 inches.

I am, Gentlemen, very respectfully,
Your obedient servant,
WILLIAM NORRIS.

POSTSCRIPT.

PHILADELPHIA, April 4, 1837.

Gentlemen,—Will you please add to the performances of the La Fayette Engine the following:—

On Saturday last, (1st instant,) she took out the enormous load of 332,330 lbs. behind her, exclusive of weight of Engine and Tender—the weight is given me by the Weigh Master.

Yours very respectfully,
WILLIAM NORRIS.

We give the following extract from a letter written by a gentleman in Michigan, in relation to an article published in a recent number of the Journal, as we give many other communications, on the authority of those from whom we receive them—our object is always to give correct information.—[Editor Railroad Journal.]

To the Editors of the Railroad Journal.

"In the last number of your Journal received here (St. Clair, Michigan,) is a statement relative to the Western Railroad through Canada, and the Northern Railroad through, or across the peninsula of Michigan, that is not exactly correct. I will therefore give you a brief statement of the exact present situation of the two Roads in question. The Great Western Railroad (as it is called) commences at Hamilton, (head of Lake Ontario,) runs to London and thence to Chatham, on the Thames, the point of termination on the River St. Clair, has been left open for three objects, firstly, for a survey, secondly, that it may be carried to that point which will connect it with the Michigan Northern Road, and lastly, that it *possibly* may be carried from Chatham to Sandwich, opposite Detroit before it shall be carried farther West. The Senate of Michigan Legislature have just passed a bill (which no doubt will receive the sanction of the lower house,) providing for the construction of the St. Clair and Romeo Railroad, and for its final extension across the peninsula to Lake Michigan. You therefore will perceive at a glance that the communication from Albany to Lake Michigan via the Western Railroad, (when that shall be carried west to the St. Clair River) will be by this road without reference to Lake Huron or Fort Gratiot, as indeed it should be, this being decidedly the best route, whilst the Fort Gratiot Road never had an existance at all, except in the train of its projectors."

Respectfully, your obt. servt.
H. N. MONSON,
Secretary and Treasurer.

We welcome CLINTON to our columns again; and trust he will not again forget that the subject on which he writes is one of vast importance to this city—and that

the columns of the Journal are open to its discussion.

The facility of opening an easy communication between this city and Wyoming Valley, and coal region, is not properly understood—although one in which every inhabitants is deeply interested. If "Clinton" will aid us it shall not be our fault if it is not better understood hereafter.—[Editors Railroad Journal.]

For the Railroad Journal.

CLINTON. NO. VI.

The Susquehanna River running a south east course from the New-York State line, breaks through the monntains, and enters the Valley of Wyoming. Within 80 rods after its debouch into the Valley, it receives from the east, the Lackawanna River; then turning to the south west, the Susquehanna flows in a placid sheet of water, but once slightly entangled, twenty miles to Nanticoke. In this distance of twenty miles, the mountains recede; so that, in the centre, from the top of one mountain to the top of the other, on the opposite side of the river it is about six miles. At Nanticoke they approach each other quite near, are precipitous and high; here too are the Nanticoke Falls. The water, compressed between these giant, and rugged hills, tumbling and dancing over the dam now erected at the Falls renders the scene strikingly grand, the Valley on both sides the river, has a large extent of bottom land, or river flats, on the west side, about the middle of the valley, the flats extend two miles back. These lands are extremely rich, easy to work, and almost inexhaustible in their productiveness. The uplands in the Valley, though not naturally so fertile or easy of tillage, yet, under good management, are made to produce wheat, corn oats, and grass, in abundance. Many are of opinion, that Wyoming Valley was once a lake, and the hypothesis is not without numerous facts and cojent reasons to sustain it. About half way down the Valley, on the easterly bank of the river, stands Wilkesbarre, 'the county town of Luzerne. It is beautifully situated, laid out into handsome squares, has besides the country buildings, a Methodist, and a Presbyterian Meeting House; an Episcopal Church and an Academy. That the Church and Presbyterian Meeting Houses, has each an organ, speaks well for the spirit and taste of the inhabitants. There are three or four points of view from which the Valley may be seen to advantage. From the top of Inman's hill, half way from Willkesbarre to Nanticoke, from the top of Ross' hill, half way from Kingston to Plymouth, from Prospect-rock on the mountains south east of the Borough of Wilkes-Barre. The summer view from the first, presents below, the large sheet of water, formed by the Nanticoke dam; the hills and dales of Hanover and Newport; farm houses and orchards, highlands covered with sheep, meadows alive with cattle, the flats waving with grass. On the opposite side of the river the rich Shawney flats and the thriving village of Plymouth. To the north east, you behold the Susquehanna like a beautiful ribbon, checked with islands wending slowly through the charming vale, as if it lingered, loath to leave a spot never equalled in loveliness. The spires and white houses of the Borough—the long bridge spanning with its noble arches, the wide river. How tame are words! How inadequate all power of expression! to give even a faint idea of the loveliness of this summer prospect! Campbell's painting from the bright region of Fame, with a rainbow for his pallet, could convey no just impression of its surpassing beauty. Governor McKean, then a Judge of the Supreme Court, near half a century ago, on coming to the mountains that overlooked Wyoming, referring to the contest then raging between the New-England men and the Pennsylvanians for the Canal, said, "beautiful indeed! and yet it is no wonder such a spot should be the object of eager contention."

Rich and beautiful as is the prospect on the surface, it is cold, dead and lifeless, compared either with the riches or beauty of what lies beneath the soil. Visit the Plymouth mines. Visit Bennett's great mine at Pittston. Drive your carriage between the pillars of Anthracite in the great Baltimore mine; see the glittering coal reflecting all hues of the rain-bow, consider how necessary to human happiness, to prosperity, even to existence. See the inexhaustible stores, the boundless deposites, and say if another spot so rich and beautiful exist on earth. Wyoming Valley is about twenty miles in length, and may average four miles in width. At a greater or less depth all this has layers of coal beneath the surface; that would be eighty square miles, or 51,200 acres; but that which lies beneath the River or River flats will not be worked for two centuries; this takes up half from present use or present value, leaving about 26,000 acres. But experience has shown that, generally, on the east side of the River, mines near the mountains, say a strip 1½ miles wide from the lower to the upper part of the Valley, the coal lies much more accessible, level, free and easy to be raised. Why, gentlemen, a year ago, J. J. Astor might with his single purse, have monopolized the coal in Wyoming that will be worked for the next hundred years. It is too late now. Numerous capitalists have been purchasing, and lands have risen an hundred per cent. Hundreds are lots that could have been bought for 15 or 20 dollars an acre, now sell for from 30 to 40; and in particular instances have run up to 80 or 100 an acre. But a great deal is yet in market, and prices are not yet up to one fourth the intrinsic value of the land. Take these facts, the veins of coal most accessible are from 12 to 24 feet in thickness, the average 18 feet. Now a cubic yard is estimated to weigh a ton. An acre then may be fairly calculated to yield 30,000 tons of coal. How much deeper, veins would add it is hardly necessary to inquire. Many persons in Schuylkill, who own veins rent them out, receiving as rent 50 cents a ton for the coal taken. At that rate an acre of coal land would be worth 15,000 dollars. Where is the error in this. Yet coal lands are selling in Wyoming for from 15 to 20 dollars an acre, richly worth 500 taking all chances; and a most advantageous investment of capital at 100 dollers per acre.

The Canal to tide from Columbia is pushing on to completion. Coal then may be taken by that route to New-York or Boston, at a price not to exceed five dollars a ton, estimating coal in the mine at 40 cents a ton. The bill on its passage in Pennsylvania,—already appropriates six hundred thousand dollars to the north branch Canal. Presently the way to the little and great lakes, to Seneca, Cayuga, Erie and Ontario, will be open to Wyoming Anthracite, and without a competitor. The Morris and Lehi Canal are now just completing too, within sixteen miles of the seat of Wyoming, and a law has just passed authorising the Lehi Company to make a Railroad to the Valley, which will, probably, forthwith be done. Coal can then, by that route, be delivered in New-York at $4.80 cents. Bear in mind that Pittston, at the junction of the Lackawanna with the Susquehanna, not surpassed in deposites of coal, is only 106 miles from the Park—only 106 miles on a straight line from your City Hall! A Railroad from Newburgh and a Railroad from Elizabethtown point, are projected to meet at Stroudsburgh, and thence to extend to Pittston. By these, cars of coal could go from the mine either to Newburgh or your city in a day.

Oow comes the main object of this communication; why is not your city awakened to the importance of this matter? why is not a bold and decisive effort made to parti.

cipate in the coal trade? Behold how Western Philadelphia has grown up under the wholesome stimulus and nutriment of her coal business.

New-England capital and enterprise would find in Wyoming sources of great public usefulness, and individual wealth. Wyoming is just opening to the world. Nothing can retard its prosperity. But those who mean to share in the exciting scenes of speculation that are about to take place this summer, while thousands and tens of thousands will be won, should come with long purses and cool heads. This matter of wild speculation is to be regretted, but inevitable—the prize is too rich, not to be struggled for.

To the Editors of the R. R. Journal:

ON THE RETARDATION OF THE VELOCITY OF STEAMBOATS IN ASCENDING RAPIDS. BY M. R. STEALEY, CIV. ENG., FRANKFORT, KY.

It is a well ascertained fact, that a steamboat having a given power, capable of propelling at a certain maximum velocity on still water, cannot ascend a rapid where the velocity of the current is nearly equal to the speed attained on still water, and that the progress of the boat in ascending a rapid added to the velocity of the current, is not as great as the velocity of the boat on an expanse of water void of motion; and consequently, that the speed of the boat in stemming a current, is retarded in a greater ratio than the opposing velocity of the current would seem to indicate—there is then evidently some new opposing or retarding force to be encountered in ascending a rapid, in addition to that of the current; and it is believed, that the greater part, if not the whole of this force, is attributable to gravity.

In elucidation of this position, it may be observed, that when there is motion in the water occupying the channel of a river, there is also a proportionate descent in its surface in the direction of that motion, or current; one is a necessary consequence of the other, each being to some extent modified by local causes. It will then be perceived, that the surface of water running in an open channel assumes the form of an inclined plane, upon which, when a boat ascends, it not only encounters the resistance of an opposing current, but also that which gravity opposes to the ascent of bodies on inclined planes.

Having all the necessary data given, it would be easy to calculate the amount of power, necessary to overcome the gravitating force of a body on an inclined plane, by the ordinary formula, applicable to the motion of bodies on stationary planes.—The surface of a rapid, however, is not a *stationary*, but a *moveable*, plane; and it becomes necessary from this cause, to adopt an essentially different method of calculation from the forms, in order to arrive at the true result. And it may be observed, that the omission to draw this distinction between stationary and moveable planes, has heretofore been the cause of underrating the resisting force under consideration. If a body moving on a fixed plane, possesses sufficient power within itself, to propel it along the plane, at a given velocity, the amount of power expended by the body, is precisely the same as would be expended, when the plane moves with the same velocity in an opposite direction, and the powers of the body is exerted in maintaining a fixed position in reference to any stationary object beyond the plane. And generally, the resistance to the motion of a body traversing a plane, and the power expended in order to overcome that resistance, should be estimated by the resistance which the body traverses on the plane, whether the latter is moveable or stationary.

It will be readily perceived from the preceding remarks, that in the case of a steamboat ascending a rapid, an instance presents itself when the plane is moveable, and the body by its inherent power exerts a force to pass along that place. For the sake of illustration, we will assume a rapid, the ratio of inclination of which is 1 foot in 500, with an uniform velocity of 500 feet per minute. On such a current, a body left to itself, would be carried down 1 foot of perpendicular height, in each minute of time. Now, if this body can exert a force capable of moving itself up this plane, at a relative velocity equal to the velocity of the plane or current,—the body will then be stationary in reference to any *fixed object on the shore;* but it is evident, that at the end of each minute, it will be in a position on the plane *one foot higher*, than the position it occupied on the plane at the beginning of the minute, because by the hypothesis, the current would have descended through that perpendicular height in this space of time. Here then are two forces acting in opposition to each other. One, the current exerting a force equal to taking the body downward through one foot in one minute, and that exerted by the body in maintaining a stationary position; the latter counteracting the former they are in equilibrio, and consequently equal—and, therefore, although the floating body or boat has *actually* remained stationary, it has *virtually* expended power sufficient to have raised itself through one foot of perpendicular space in one minute of time.

The power expended therein, overcoming the force of gravity on moveable planes or currents, should be estimated, not by the *actual* height to which the floating body of boat is elevated, as ascertained by reference to some fixed object beyond the plane, or on the shore; but by the virtual *height measured on the plane itself;* and this, for any given time, will be estimated by the relative distance traversed, and the perpendicular elevation due to that distance by the ratio of the inclination of the plane.

Let W = weight of the boat in tons.
V = virtual velocity of the boat per minutes.
H = Height of the plane.
L = Length.
T = Time of ascent.

(15 = No. of tons raised 1 foot high in 1 minute equal to 1 horse power) and N = No. of horse power necessarily exerted at each instant of time, to overcome the graviting force, and A = the aggregate mechanical force expended in the time T expressed in horse power acting for 1 minute.

$$-\frac{W\,V\,H}{15\,L} = N.$$

or making J the inclination of the plane, we have

$$\frac{W\,V\,(\sin.\ J)}{1\ 5} = N.\ \text{and}\ N\,T = A.$$

In the foregoing investigation, the current is assumed to have uniform velocity; when the rapid is long and deep, however, the velocity of the current will be accelerated. The greater the depth of water on the rapid, and the more direct its course, the nearer the accelerated motion will approximate to the velocity assigned by theory to the motion of a body rolling down an inclined plane—and the less the depth of water, and the more sinuvus the channel, the more closely the current will approach to an uniform velocity. In fine, the accelerating force is so much dependent on, and modified by local circumstances, that no formula admitting of general application, can be given, from which the accelerated velocity can be deduced, and it can therefore only be ascertained by observation. When the motion is accelerated, the formula above given can be applied, by dividing the rapid into sections, considering each separately, and thence deducing a general result.

The following statement from the New-York Evening Star will give a good idea of the *un*-certainty of Railroad travelling in Winter. We shall be greatly obliged to those in charge of *other* Railroads if they will write and give us a statement of the number of days delay caused by the severity of the weather, on the roads under their charge.—[Editors Railroad Journal.]

From the New-York Evening Star.

WINTER TRAVELLING—RAILROADS.—The

facilities of winter travelling, and the skill and energy in using them have so much increased, that fewer interruptions have taken place on many of our public roads this winter than has heretofore existed during the same season of the year. A short notice of some of the facts may be interesting.

The improvements in snow ploughs and scrapers have demonstrated that travelling over railroads can be continued in winter with nearly the same certainty as in the mild season of the year. The snow and ice during the last winter, though less than the preceding season, was about the same which is usual on our winters—still the impediments to travelling over *railroads* was overcome in a great degree, and they were very little interrupted between the commencement of the winter and the opening of the spring.

The transportation of goods and passengers over the

Lowell Railroad was stopped only two days.		
Boston and Worcester Railroad	do.	
Boston and Providence	do.	one day.
Camden and Amboy	do.	part of a day.
New-Jersey	do.	do.
Utica and Schenectady	do.	one day.
Mohawk	do.	do.

How much the Pennsylvania and Southern roads were interrrupted is not at present known to us, but it may fairly be inferred that the general improvements alluded to, have produced similar results there.

From the Long-Island Star.

Williamsburgh Branch of the L. I. Railroad. Why not let the Locomotive come into Brooklyn?—We understand that the work on this branch has been commenced. It is intended that the locomotive, without any delay, shall take the passengers from Bedford to the ferry. The Corporation of Williamsburgh have been wisely regardful of the interest of their city, in granting this permission.

With care in managing the engine, and proper precautions to give timely notice of its approach, we know not why all the expense and delay of the horse establishment at Bedford may not be avoided, and the current of country travel be continued in its accustomed channel.

The subject of permitting the engine to come into Brooklyn, is one of most pressing importance. It should immediately receive the attention of the Corporation of Brooklyn and of the citizens.

If public opinion were tested on the subject, we have no doubt that the engine would be permitted to come into the city so as to give passengers ready and rapid access to the ferries. Different circumstances exist now from those attending the commencement of the Company's operations, and these circumstances require prompt action and a ready adaptation of means to the preservation of the interests of the city.

Several routes have been proposed in addition to the present track upon Atlantic-street, by which a safe and convenient entrance could be made into the city. It has been suggested that the Redford road as lately laid out, continued to any point within the city, would secure all the advantages required.

Let ready means be taken by the Common Council for securing a full examination of this subject in as short a time as possible. There is no subject at present agitated which so much demands attention!

Commerce and Navigation of the United States.—The statements of the Commerce and Navigation of the United States, annually prepared at the Treasury Department, have just been completed for the year ending the 30th of September, 1836. The following is a summary of the whole, reported to the Secretary by the Register of the Treasury:

The imports during the year ending on the 30th September, 1836, have amounted to $189,980,035, of which there was imported in American vessels $171,656,442, and in foreign vessels $18,323,593. The exports during the year ending on the 30th September, 1836, have amounted to $128,-663,040; of which $106,916,680 were of domestics, and $21,746,360 of foreign articles. Of the domestic articles, $80,845,-443 were exported in American vessels, and $26,071,237 in foreign vessels. Of the foreign articles, $16,282,366 were exported in American vessels, and $5,463,994 in foreign vessels.

1,255,284 tons of American shipping entered, and 1,315,523 cleared, from the ports of the United States. 680,218 tons of foreign shipping entered, and 674,721 cleared, during the same period.

The registered tonnage, as corrected at the office, for the year ending on the 30th September, 1836, amounted to	897,774
The enrolled and licensed tonnage amounted to	872,023
And the fishing vessels to	111,304
Tons	1,882,102
Of the registered tonnage, amounting, as before stated, to	897,774
There were employed in the whale fishery	144,680
The total tonnage, of shipping built in the United States, during the year ending 30th September, 1836, amounted to—	
Registered vessels	46,645
Enrolled do	66,982
Tons	113,627

From the Oswego Advertiser.

THE GREAT WESTERN RAILROAD COMPANY.

This is the style of the new company formed in Upper Canada under the sanction of the Provincial Parliament, from the London and Gore Railroad Company.—The Parliament has also passed an act, granting, by way of loan to the company, the sum of $800,000. The work is to be commenced with the opening of the Spring. The line of road is from Hamilton, (on Burlington Bay,) at the head of Lake Ontario to Point Edward, at the foot of Lake Huron, and opposite to Fort Gratiot. The distance is 132 miles. From London we understand a Southern branch, along the Thames, is to be extended to Chatham, the head of Steamboat navigation on that river. Thence is every facility for Steamboat communication with Detroit.

There is no Railroad on the continent of more value or likely to be productive of greater results than this. It will effect a communication between New-York and the remote West, with which no other route can contend. A reference to the map will satisfy any one, that by this route a passage can be accomplished from New-York to Fort Gratiot, in Michigan, in 40 hours! and in 42 hours to Detroit!! When the Michigan Railroad, across the Peninsula, is completed, the distance between New-York and Chicago will be only from 55 to 60 hours! This may be easily shown:

From New-York to Albany, by steamboat,	10	hours.
" Albany to Oswego, by railroads,	10	"
" Oswego to Hamilton, by steamboat,	12	"
" Hamilton to Detroit, *railroad*,	10	"
	42	"
" Detroit to Chicago, by R. R. and S. B., about	15	"
	57	"

From the Pittsburgh Working Mens' Advocate.

TRADE OF THE CENTRAL PARTS OF THE UNITED STATES.

Few persons, even amongst those most interested, unless they have very carefully attended to the ranges of the river vallies on each side of the Appalachian system of mountains, can have formed an adequate idea of the peculiarly advantageous position of Pittsburgh. But from some recent evidence we are inclined to believe that more correct views have been taken of the commercial value of this city, in New-York, than has been taken in Philadelphia.

TRADE OF THE WEST.

The favorable position of Baltimore, in reference to the trade and intercourse with the West, is strikingly exemplified in the following paragraph from the New-York Express:

"There is a plan on foot for organizing a Steam Freighting Company, the object of which is to transport goods from this city to Baltimore. It is stated that goods could be shipped by this route and reach Pittsburgh in one hundred hours. This would be an immense thing for the West. The plan is already before the Legislature of this State for a charter."

The preceding was cut from a Baltimore paper, we now place it before those most concerned. The Baltimore editor says—"This will be an immense thing for the West." So it would, but it would be a much more vast thing for the East. By a calculation on data, we boldly say of the soundest kind, there will in 1850 exist within that part of the United States westward of the great Appalachian system of mountains upwards of thirteen million of inhabitants. It will, of course be a boon of no small value for any city to be the principal Atlantic depot or emporium for the trade

of such regions. This is a subject we shall take care not lose sight of, but at present we confine ourselves to Pittsburgh.

Few who have heard the name of this city, but who know that it occupies the ground around the junction of the Monongahela and Allegheny rivers, but comparatively few are acquainted with the remarkable features of these two streams. The Allegheny has its remote sources in New-York at N. lat. 42° 20′, and with large inflections but with a general course a very little west of south, and receiving most of its tributary waters from the eastward and from the mountains.

The Monongahela has its highest sources in Virginia, at about N. lat. 38° and 40′, and pursuing so nearly a due northern general course, that a meridian line passing through Pittsburgh, passes also very nearly over the extreme fountains of this river.

From the preceding elements it is seen that the two constituent streams which form the Ohio river at Pittsburgh, flow almost directly towards each other. It may be here remarked, that the mountain structure by no means terminates with those most prominent ridges or chains to which by pre-eminence has been given the title of mountains: and again, that the streams, particularly in Pennsylvania, Maryland and Virginia, which rise in the Appalachian valleys, as soon as they assume the size to deserve the name of rivers, flow either along those valleys or almost at right angles to them. Any person may satisfy themselves of the correctness of these remarks by examining on a map the general course of the Delaware, Susquehanna, Potomac, and James rivers. In none, however, of those Atlantic streams are these features in physical geography more striking than in the general courses of the Allegheny river. At their junction the united streams under the name of Ohio apparently continues the general course of the Monongahela, which is not by any means the case. The general course of the latter river from its source to the mouth of Turtle Creek, eight miles above Pittsburgh is maintained, but here in obedience to the natural laws of the rivers of this region it inflects to North-West, at right angles to the general range of the mountains, and pursuing that course joins the main branch and the now combined volume piercing a real chain of the Appalachian continues a northwestern direction to the influx of Beaver river, below which it gradually curves until assuming the general course of the principal constituent stream, the Allegheny, flows upwards of one hundred miles very nearly parallel to the Monongahela, but in a directly opposite course.

From the sources of the Monongahela to within eight miles of its mouth, the distance between it and Ohio is about a mean of fifty miles, and the intermediate space traversed nearly centrically by a ridge, which though not usually regarded as such, is in fact an Appalachian spine, which is again continued between the confluents of Allegheny and Beaver. The city of Pittsburgh therefore, occupies a position in one of the river passes, and the only deep gorge in existence from the mountain into the interior of the continent between the sources of the Allegheny to those of the rivers which contributed to form the Mobile and Appalachicola.

In fine, examining the combined features of this projection, with the relative geography of the whole region in which it is situated, it may at once be pronounced as unequalled. It is remarkable, that in the struggle between Philadelphia and Baltimore for the western commerce, Pittsburgh may remain tranquil as regards the contest. Let the Atlantic emporium be on the Delaware, or on the Chesapeake, or Potomac, or let emporia be formed on all these, which must indeed be the case, still the Ohio at Pittsburgh must receive the largest share of the transit commerce.

Again, the advantages of this remarkable position, are not to be bounded by the Ohio trade, as it is just as completely secured by nature to form a point on the great line of lake trade, as it is for that of the Mississippi basin. Let this line be completed by whom it may, and let its Atlantic termination be where it may, the line will follow the great gorge of the Ohio from Pittsburgh to Beaver, and thence by the latter, and thence to Cleaveland.—Those who are most ready to follow the suggestions of nature will profit most, and let it be known to all whom it may concern—that the laws of nature are like those of the Medes and Persians.

From the Oswego Advertiser.

☞ The Provincial Parliament of Upper Canada was prorogued on Saturday, the 4th March, instant. 152 bills were passed this session in the Lower House, and 107 in the Legislative Council. This looks like doing business. The Lieut. Governor, in his speech, on closing the session, highly compliments both branches of the Legislature, on the harmony and mutual good feeling which has prevailed between them.—On the subject of Internal Improvement, he says:

"The next measures of this session to which I deem it proper particularly to advert, are those which relate to the Internal Improvement of the Province, *such as the completion of that noble undertaking, the Welland Canal:*

The formation of the Great Western, and also of a Northern Railroad:

The opening of the Navigation of the River Trent:

The survey of the Ottawa:

The general improvements of the roads, (a portion of which are to be MacAdamized,) and various grants for the formation of harbors, &c."

From the Springfield (Mass.) Journal.

RAILROADS.

The annual reports from the different Railroad Corporations in this State, have been submitted to the Legislature and printed. The Western Railroad has been surveyed and located nearly to Connecticut River, and double the experimental surveys originally deemed necessary, west of the River, have been made. The distance from the freight depot of the Boston and Worcester Railroad in Worcester, to the Connecticut River is 54 miles—thence to the State line, West, 63 miles, making the entire length of the road 117 miles. There is no grade between Worcester and Connecticut River exceeding 50 feet per mile, and the entire line is free from short corners. The line from East Brookfield to Stony Hill in the west part of Wilbraham, is about 27 miles, and pursues the general course of the Chicopee River. The first section, from Worcester to Brookfield, is under contract and the work commenced, and the other portion will be ready for grading on the opening of the spring. Although the route from Stony Hill to Connecticut River, (about 7 miles) is not yet officially located, it is generally understood that the "Garden Brook route" is approved of as the best, and that the road will strike the river just above Springfield Bridge. Locomotive power will be sufficient for any part of the road, west as well as east, of the River. Receipts of two installments, \$300,000; interest on do. \$2,899. Expenses to January 14, Engineer Department, including survey, \$30,319 36—incidental expenses, \$9,757 97—paid for land damages, \$220.

TRANSACTIONS OF THE INSTITUTION OF CIVIL ENGINEERS.

III. AN ACCOUNT OF SOME EXPERIMENTS ON THE EXPANSION OF WATER BY HEAT. BY THE LATE T. TREDGOLD, M. INST. C. E.

The expansion of water, by increase of temperature, is one of those experimental subjects that has not received the degree of attention its importance would lead us to expect; but, as even the smallest addition to any part of knowledge contributes towards its increase, I have ventured to send this mite for the consideration of the members of the Institution.

I began by a series of trials with a thermometer, containing water instead of mercury, to find the point at which the volume of water is a minimum, by cooling successively down to 32° with snow and water, and observing the decrease of bulk, which continued till the temperature was 40°; the rise again was then sensible. In like manner by cooling, the decrease continued till the temperature was about 39°, when the rise became sensible. So small and uncertain, however, was the rate of increase or decrease, that we may practically estimate 40° as the temperature corresponding to the maximum density of water.

Having marked the tube at the point when the temperature was 40°, and also another point within the range of the tube, I divided the distance between these, into four equal parts. With this precaution I immersed the water thermometer, and a mercurial one, in a vessel of hot water, and as it cooled compared the temperatures as the water contracted to each division on the tube. The mean of several trials was as follows:

Temp. 112°	4th or upper division.
— 104°	3d.
— 90°	2d.
— 74°	1st division.
— 40°	maximum density.

I intended to repeat the trials and to correct these numbers; but the cold weather commenced, and instead of attending to the higher degrees of heat, my attention was directed to the lower ones. The bulb of the thermometer was immersed in a mixture of snow and salt, and a mercurial one placed beside it, but I found the two were not alike affected by the mixture; the water thermometer rose rapidly till it arrived at, or very near to the third division on the tube, when it exploded. At the moment of explosion, the central part of the mass of water, and that in the tube were both perfectly fluid, and the fragments of the bulb were lined with a thin coat of ice, beautifully crystallized. The fractured bulb presented a singular appearance, the whole being cracked into very fine gores, somewhat less than one-twentieth of an inch in breadth at the middle, and exceedingly regular.

The temperature of a mixture of snow and salt is —5°, or 5 degrees below zero; hence, if the expansion below 40° had been the same as far above 40° the thermometer ought not to have risen quite to the second division; but, as it rose very nearly to the third division, it seems that the expansion below 40° is much greater than at a corresponding number of degrees above 40°; and that the common opinion is not quite correct in this respect.

I have not had leisure to follow up these trials, for they consume an immense quantity of time; but from those made by others, and checked by my own, I have deduced a formula for calculating the expansion at any temperature.

If we consider the force with which matter resists the entrance of heat to be inversely as the square of the distance of its elementary atoms; then, the bulk being as the cube of the distance, the resistance to heat will be inversely as the square of the cube root of the volume, and the increments of expansion by heat directly as the $\frac{2}{3}$ power of the volume. The sum of the increments will, therefore, be as the $\frac{5}{3}$ power of the volume, and the equation must give zero at 40°; hence it will be $A\,(t - 40°)^{\frac{5}{3}}$ = the expansion, where A is a coefficient to be found by experiment, and t denotes the temperature.

The calculation is easy enough by logarithms, for, $\log A + \frac{5}{3}\log(t - 40)$ = log of the expansion;

$$\text{or } 3\left(\frac{\log \text{expansion} - \log A}{5}\right)$$

$= \log(t - 40°)$.

The formula in the last form applies to my experiment, and becomes

$$3\left(\frac{\log \text{expansion} + 3\cdot09555}{5}\right) = \text{the log}$$

$(t - 40)$, the expansion at 112° being considered unity; hence the comparison is easy, and is as under.

Expansion.	Temperature by experiment.	Temperature by formula.
1	112°	112°
0·75	104°	100°
0·5	90°	87°
0·25	74°	71°
0·00	40°	40°

The coincidence is as near as we could expect, considering how difficult it is to insure perfect accuracy in the observations; but, before we proceed further in experiment, it is natural to ask how it will agree with others already made.

The expansion of water from 40° to 212° has been found to be 0·04333, its bulk at 40° being unity. By substituting this value in the formula, we find the coefficient A, and have the rule $\frac{5}{3}\log(t - 40) + (-3\cdot910909)$, or its equivalent $\frac{5}{3}\log(t - 40) - 5\cdot089091$ = the log of the expansion.

The formula being in this case derived from a probable hypothesis, it is more likely to express the true expansion, than one made out merely to fit a short range of experiments. The absurd conclusions which may follow from an experimental rule are avoided; and that such conclusions do arise out of formulæ made to fit a particular set of experiments, we have an evidence in the case under consideration; for Dr. Young* has given a formula for calculating the expansion of water, which becomes negative when the temperature is 540°; indicating that water would decrease in bulk, by increasing its temperature above that point; this is a cirumstance too improbable to guide us in any practical application of the fromula.

The annexed Table shows the bulk and expansion for a few temperatures.

* Lectures on Natural Philosophy, Vol. II. p. 392.

Temperature.	The expansion. By experiment.	The expansion. By formula.	Bulk by formula.	Temperature.	Expansion by formula.	Bulk.
40°	0	0	1·0000	400°	0·1484	1·1484
64°	0·00133	0·00162	1·00159	800°	0·5155	1·5155
102°	0·00760	0·00791	1·00791	1000°	0·7610	1·7610
212°	0·04333	0·04333	1·04333	1171°	1·0000	2·0000

In my own experiments, the formula was in defect in the temperatures between 40° and 112°; here it is in excess; the difference may arise from the expansion of the glass in my trials. According to this formula, water will expand to double its bulk at 40° by a temperature of 1171 degrees. What would be the force of the steam to confine it to the liquid state at that temperature? There is abundant scope for curious research in this matter: it is one where speculative opinion feels the want of experience.

I am not aware of there being any experiments on the expansion of water above the boiling point. When I find an opportunity, I intend continuing the series as I can, using something to color the distilled water, for facility of observing; and I trust soon to be able to communicate some account of my progress.*

* It is not certainly known whether Mr. Tredgold ever followed out the consideration of this interesting subject; but, as he made no further communication thereon to the Institution, and his premature death took place soon after the date of this paper, it seems probable that his experiments were never resumed.

IV. PARTICULARS OF THE CONSTRUCTION OF THE LARY BRIDGE, NEAR PLYMOUTH. BY MR. J. M. RENDEL, CORR. M. INST. C. E.

As this bridge is founded on a shifting sand, in a rapid tideway, and presents some novelties in the design, it is hoped that an account of the methods successfully adopted for laying and securing the foundations, and some particulars of the superstructure, will be acceptable to the members of the Institution.

The Lary, over which this bridge is built, and from which it derives its name, is the estuary of the river Plym, and connected with Plymouth Sound by Catwater. The general width of the estuary is half a mile, but at the site of the bridge the shores abruptly approach each other, and form a strait between 500 and 600 feet wide.—The tide rushes through this strait with a velocity of 3 feet 6 inches a second, and flows on an average 16 feet perpendicular. The depth at low water is from 5 to 6 feet.

By boring it appeared that the bed of the river was sand to the depth of 60 feet—the lofty lime rock on each shore dipping abruptly from high water, and forming a substratum nearly horizontal across the strait. The sand in the wide parts of the estuary above and below the bridge is fine; at the site of the bridge the current leaves only the coarser kind; but this is not sufficient to resist the heavy land floods, to which the Plym is liable, and it frequently happens that the bed of the river is scoured away several feet in depth in winter and refilled in the summer.

When called on by the Earl of Morley, who built this bridge at his sole expense, to prepare a design, I furnished one on the principle of suspension, spanning the whole width of the strait, and having the towers on its rocky shores. Our president* was consulted by his lordship, and the plan being approved of by him, an act was obtained in the session of 1823 authorising its erection; but on the commencement of the works, difficulties arose which led to the abandonment of the suspension bridge and the ultimate adoption of the present one of cast iron.

The drawings (see Plates I. and II.) which accompany this paper, will, I trust, give a general idea of the finished structure. The arrangement of the design differs materially from other works of a similar nature: first, in the masonry of the piers finishing at the springing course of

* The late Mr. Telford.

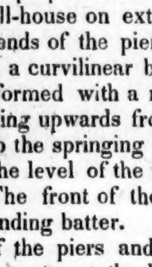
the arches; secondly, in the curvilinear form of the piers and abutments; and thirdly, in the employment of elliptical arches. The adoption of these forms for the piers and arches in unison with the plan of finishing the piers above the springing course with cast iron instead of masonry, has, as I had hoped, given a degree of uniform lightness, combined with strength, to the general effect, unobtainable by the usual form of straight sided piers carried to the height of the roadway, with flat segments of a circle for the arches.

Having given these particulars of the situation and design of the work, I will now add some information as to the proportions of the several parts of the structure.

The centre arch is 100 feet span, and rises 14 feet 6 inches; the thickness of the piers, where smallest, being 10 feet. The arches adjoining the centre are 95 feet span each, with a rise of 13 feet 3 inches. The piers taken, as before, are each 9 feet 6 inches thick. The extreme arches are each 8 feet span, and rise 10 feet 6 inches. The abutments are in their smallest dimensions 13 feet thick, forming at the back a strong arch abutting against the return walls to resist the horizontal thrust. The northern abutment forms a considerable projection, which was deemed advisable in consequence of the obliquity of the adjoining wharf below the bridge; as well as to afford the noble proprietor an opportunity of building a toll-house on extra-parochial ground. The ends of the piers are semicircular, having a curvilinear batter on the sides and ends formed with a radius of 35 feet, and extending upwards from the level of high water to the springing course, and downwards to the level of the water at the lowest ebb. The front of the abutments have a corresponding batter.

The parts of the piers and abutments which lie under water at the lowest ebbs, are composed of 2 feet courses of masonry with offsets, as will be better understood by reference to the drawing. (See plates.)

The roadway between the abutments is 24 feet wide, supported by 5 cast iron equidistant ribs. Each rib is 2 feet 6 inches in depth at the springing, and 2 feet at the apex by 2 inches thick, with a top and bottom flange of 6 inches wide by 2 inches thick, and is cast in 5 pieces; their joints, (which are flanged for the purpose,) are connected by screw pins with tie plates equal in length to the width of the roadway, and in depth and thickness to the ribs; between these meeting plates the ribs are connected by strong feathered crosses, or diagonal braces with screw pins passing through their flanges and the main ribs.—The springing plates are 3 inches thick, with raised grooves to receive the ends of the ribs, which have double shoulders, thus:



These plates are sunk flush into the springing course of the piers and abutments, which, with the cordon and springing course, are of granite. The pier standards and spandril fillings are feathered castings, connected transversely by diagonal braces and wrought iron bars passing through cast iron pipes, with bearing shoulders for the several parts to abut against. The roadway bearers are 7 inches in depth by $1\frac{1}{2}$ thick, with a proportional top and bottom flange; they are fastened to the pier standards by screw pins through sliding mortices, whereby a due provision is made for either expansion or contraction of the metal—the roadway plates are $\frac{7}{8}$ of an inch thick by 3 feet wide, connected by flanges and screw pins, and project 1 foot over the outer roadway bearers, thus forming a cornice the whole length of the bridge.

After what has been stated of the character of the river and nature of its bed, it is unnecessary to remark that extreme caution was indispensable in preparing and securing the foundations.

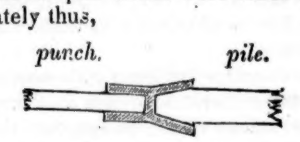
We commenced by driving sheeting piles to a depth of 15 feet around the whole area of the base of the piers and abutments.—These piles are of beech plank, 4 inches thick, having their edge grooved to fit thus:

and were driven in double leading frames fixed to temporary guide piles:—great attention was paid to have them perfectly close. When pitched they were from 16 to 18 feet long, properly hooped and shod with plate iron shoes, weighing on an average 2 lbs. each. These piles were driven with a cast iron weight of 450 lbs. worked by seven or eight men in what is termed a ringing engine. They were driven several feet below low water by means of punches.

As these pilings were carried on, the sand was excavated from the space they enclosed to a depth of 5 or 6 feet below the general level of the river, and from 9 to 10 feet below the level of low water of ordinary tides. These excavations were effected by means of sand spoons of the following construction. Strong canvas bags, capable of containing about 2 cubic feet of sand, were firmly secured to elliptical rings of wrought iron, each ring having a socket to receive a long wooden handle in the direction of its transverse axis, and a swivel handle through its conjugate axis. Stages were fixed on the leading frames in which the sheeting piles were driven, at about 3 feet above low water, and each spoon was worked by three men in the following manner:—a rope was fastened to the loop in the swivel handle of the spoon frame, one end of which was passed over a single block fixed a few feet above the level of the stage, and the other end was held by one of the workmen, whose business it was to pull the spoon when at the bottom towards him, while a second pressed it downwards and guided it, by means of the long wooden handle, till it was thought to be filled; the third man, who was stationed at the rope which worked through the single block, then hoisted the spoon to the stage and discharged its contents into a shoot, which drained into the river. After the laborers had become used to the work, these operations were carried on with considerable despatch, favorable tides generally affording from 3 to 4 hours' work per day.

As these excavations proceeded, the ground was piled with whole timbers of large Norway and small sized Memel, and as many of beech as could be procured of the desired length; these piles, being properly shod and hooped, were driven from temporary stages, fixed above high-water level, by weights varying, according to the size of the pile, from 10 to 15 hundred weight; they were disposed in five rows, in the width of the foundations, from 4 feet to 4 feet 6 inches from centre to centre, and were driven till they did not sink more than one inch with eight blows of the 15 hundred weight driver falling from a height of 25 feet, and then received twenty additional strokes with the same weight and fall.

These piles, none of which were less than 35 feet long, were driven to the level of the stage, and then punched to their proper depth. The punches used for this purpose were made of sound and well seasoned elm, hooped throughout their length, and having at their lower ends a strong cast iron ring, about 18 inches wide; this ring had a thick partition plate, cast in the middle of its width, which separated the head of the pile from the end of the punch; the lower end of the ring was cast a little conical, and the pile heads were made to fit it accurately thus,



By this means the pile heads were but little injured, and the loss of momentum occasioned by the intervention of a punch was reduced to a mere trifle.

The next operation was to cut off the bearing piles to their proper depth, and to pave and grout the spaces between them. The usual mode of cofferdams was manifestly inapplicable to such a bed of sand; I therefore, in an early stage of the works, proposed to the contractors that the pile heads should be levelled, and the spaces between them paved by means of a diving bell. To save expense, this bell was made of wood, and with the necessary machinery was finished and put to work within six weeks from the time it was determined on. With its assistance the works were carried on with expedition and success. When in operation it contained two men, who, being provided with the necessary instruments for cutting off the piles, paving the spaces between them, &c., continued at work for four hours, when they were relieved by two others.

As much depended on the regularity with which the pile heads were levelled, great care was bestowed on this part of the work. It was accomplished in the following manner:—the four angular piles of each foundation being cut as low as the water would permit, were accurately levelled from a plug on the shore, to ascertain how much each had to be reduced to bring it to its proper level; on each of these piles

was marked the portion remaining to be cut by the bell men, which being done, all the remaining piles were levelled from them, by means of a spirit-level, accurately adjusted in a piece of wood, sufficiently long to be applied to three piles at a time. The paving between the pile heads was performed in an equally simple and satisfactory manner.

As this econominal bell answered every required purpose, a general description of the whole apparatus may prove acceptable.

The internal dimensions of the bell were 5 feet 6 inches in length, 4 feet 6 inches in width, and 5 feet in height; the sides, ends, and top were made of two thicknesses of $1\frac{1}{2}$ inch well seasoned elm board; the inner case was constructed with its joints parallel to the top and bottom or mouth of the bell, whilst those of the outer one were vertical, or at right angles to the inner joints; the top joints were crossed in the same manner as the sides; all the joints had a slip of flannel, saturated in a composition of bees' wax, laid between them, and were dowelled together and set as close as possible by means of screw clamps, &c., the sides were rabbeted to the end, and the internal angles were strengthened with brackets. The whole surface between the inner and outer case was covered with double flannal, saturated as just described, and was then connected together by a number of wooden pins, dipped in tar and tightly driven; the top was perforated with six holes of 6 inches diameter each, in which was firmly fixed a corresponding number of strong lenses set in white lead; a hole of 3 inches diameter was made in the centre, in which was fixed a brass pipe with a screw to attach the air tube; four hoops of wrought iron, two internal and two external, were screw-bolted together through the sides and ends of the bell: internal and external cross-lacings were also screw-bolted to those hoops, and to the sides and top of the bell. In these lacings, the chains by which the bell was suspended, were fixed in strong iron eyes, which passed through the top of the bell, and were riveted to the inner lacings. All the screw-bolts were driven with tarred oakum, and every precaution was taken to render the whole air-tight. The bell thus finished weighed about 1 ton 10 hundred weight, but it required from 5 to $6\frac{1}{2}$ tons to sink it, and overhaul the ropes by which it was suspended; cast iron plates, from $1\frac{3}{4}$ to 2 inches in the thickness, were therefore hung externally round its sides and ends, till it was sufficiently loaded to sink with steadiness in about 25 feet of water.

The bell was provided with two movable seats and a foot-board for the divers, and at top long boxes were fixed, in which their tools were kept; it was supplied with air by a double acting force-pump, the cylinders of which were 7 inches diameter in the clear, the pistons making a 14 inch stroke. This pump was generally worked by four men, and made, on an average, according to the depth of water and run of the tide, about eight double strokes per minute.

Around the foundations on which the bell was to be employed, temporary piles were driven, and cut off level about 15 feet above high water, and cross braced; on the top of these piles whole Memel tembers were firmly fixed, care being taken to have the side beams parallel to each other. A strong frame, equal in length to the distance between the parallel beams of the above stage, and about 4 feet wide, mounted on four small cast iron flanged wheels, traversed on an iron railway laid on the beams; this frame was moved on the railway by means of a rope connected to the sides, and worked by two common winches, one fixed at each end of the stage; on the beams of this traverse frame a railway was also laid, on which worked a carriage, mounted in a similar manner, and sufficiently large and strong to carry a purchase machine capable of raising the bell by the labor of four men; the bell was suspended to this carriage by two treble blocks, the upper block being lashed to one of the cross beams of the frame, and the lower connected to the sling chains of the bell by a strong shackle. This traverse frame was easily moved by winches affixed to the ends of the long frame, over which ropes worked, having their ends made fast to the purchase machine frame.

By these traverse frames the bell was moved with great celerity to any part of the foundations. The machinery required the attendance of six active men, viz. one to each of the four winches, and two to the purchase machine. It was the sole business of a careful man to attend to the signals of the divers, and to direct the men at the machinery and air-pumps accordingly. The signals were communicated by a line, one end of which was fixed in the bell, and the other held by the signal-man, whose place was on the stage. To avoid confusion in the signals, any thing requiring great precision was communicated to either the divers or signal-man by means of a board attached to the line on which either party wrote with chalk, and by these means a regular correspondence could be carried on.

By means of the bell and apparatus, the works proceeded with safety and expedition, and I feel confident that diving-bells may be employed by the bridge builder in a variety of cases with much greater advantage and economy than coffer-dams.

The foundations being prepared, and guides fixed to the plank piles, caissons were floated off from the shore with one, and in some instances two courses of masonry, and sunk. The greatest success attended these operations from the care that was taken to get the foundations perfectly level: of course, the heads of the plank piles were not cut off until the caissons were sunk.

The bottoms of the caissons were made of beech plank and beams; the bottom plank was 4 inches thick and laid in the transverse direction of the pier, across which the beams 12 inches by 8 inches were placed so as to correspond with the rows of piles in the foundation. The spaces between the beams were filled with masonry set in Pozzuolana mortar, and grouted; and a flooring of 3 inch plank, closely jointed and well caulked, so as to be perfectly water tight, covered the masonry and beams. The top and bottom planks were trenailed to the beams, and the whole strengthened by a strong frame of beech, a foot square, surrounding the bottom and fastened to it by strong screw bolts and trenails.

The upper surfaces of the beams of this frame were grooved to receive a strong tongue, fitting a corresponding groove in the bottom beams of the sides and ends of the caissons, which were made in the usual way, and connected to the bottom by strong lewes irons fitted to cast iron boxes, firmly fixed in the bottom planking. The lewes irons were fixed about 8 feet apart, and were easily removed when the masonry was brought up to the height of the caisson. The introduction of the tongue in the bottom beams of the caisson proved of the greatest utility, as it prevented leaks from the slight sinkage of the bottom between the lewes irons, which it is impossible to prevent when the caisson grounds.

The caissons were furnished with sluices, and made 15 feet high, which gave the masons an opportunity of working about five hours each tide on an average of neaps and springs.

The masonry of the piers and abutments is composed of solid compact limestone, raised in the quarries of the noble proprietor of the bridge* in the adjoining cliffs, and Dartmoor granite, the latter used only, however, in the springing courses and cornices. The limestone is quarried in masses, varying from two to six tons weight, and these were taken to the work on a railroad, continued from the quarries across the river on a stage or temporary bridge, passing close to the piers and abutments, and under the stages on which the diving bell was worked as before described, and the machinery used in working the bell was applied to taking the stone from the wagons, and in setting it. This machinery was found of incalculable advantage in building with such heavy blocks of stone, moving them with ease and the minutest accuracy from over head, and, consequently, without obstructing or incommoding the builders in the caissons.

Experience having taught me that the mortar used in the construction of these works is of an excellent quality, I shall, I hope, be excused if I add to this already long paper a few words on this subject.

The blue lyas stone got from the coast of Dorsetshire was burnt at the bridge as the works proceeded, and, whilst hot from the kiln, was ground in a mill to a fine powder. It was then taken to another mill, and in its powdered state mixed with prepared Pozzuolana and sand, and ground until it formed a tough paste, no more water being used than was absolutely necessary. The best mortar, or that used in the bottom courses of the piers and abutments, and for the front work, was composed of one measure of powdered lime, one measure of Pozzuolana, and two meas-

* From these quarries the large blocks of stone used in paving the breakwater are taken.

ures of sand. The backing mortar was prepared with one measure of lime, half a measure of Pozzuolana, and two measures and a half of sand: the sand was of an excellent quality, got from the site of the bridge.

The following circumstance will sufficiently prove the goodness of this mortar. Some masonry, which had been done in one of the foundations about twelve months, had to be removed, when the stones were found so firmly united, that gunpowder was necessary to separate them.

I have before described the bed of the river to be a loose sand moved by the slightest increase of current, and that this circumstance, together with the difficulty of founding piers and abutments, induced me to propose a suspension bridge spanning the whole width of the river. It was however hoped, when a change of plan became necessary, that the plank piles, with the aid of some stone thrown round them, would be sufficient to meet the increased current occasioned by the bridge; but as the erection of the piers and abutments proceeded, the necessity of a more extended security for the foundations became manifest, as the bed of the river, for its whole width, and to an extent of from 50 to 60 feet above and below the bridge, was gradually scouring away. I therefore proposed to form an artificial bed, to the full extent to which the natural one was removed, with clay from 18 inches to 2 feet thick, and to cover the clay with rubble stone of all sizes from 200 lbs. each downwards. This plan of operation was suggested by observing these materials in vast abundance in the adjoining limestone quarry spoil hills, and after I had submitted the clay to experiment, and found it capable of resisting a current acting immediately upon it at a velocity of 7 feet per second. The clay and stone were deposited with great regularity, giving to the channels under each arch a slight concavity in the middle: the combined thickness of the clay and stone is from 2 feet to 2 feet 6 inches, and just replaces the loss of the natural bed.

By this union of materials an indestructible bed has been produced. The clay shields the natural bed from the current, whilst at the same time it forms a tenacious cement in which the stone buries itself and which is hardened by the volume of water constantly pressing on it. In six months after this work was finished, I ascertained that sea weeds were growing over its surface, and that it was sufficiently firm to resist an oyster dredge.*

Messrs. Johnson of Grosvenor Wharf, London, were contractors for the masonry, &c, and Mr. William Hazledine, of Shrewsbury, for the iron work.

The contract amount for the masonry, &c., was	£13,365 0
The contract amount for the iron	13,761 0
Making the total cost	£27,126 0

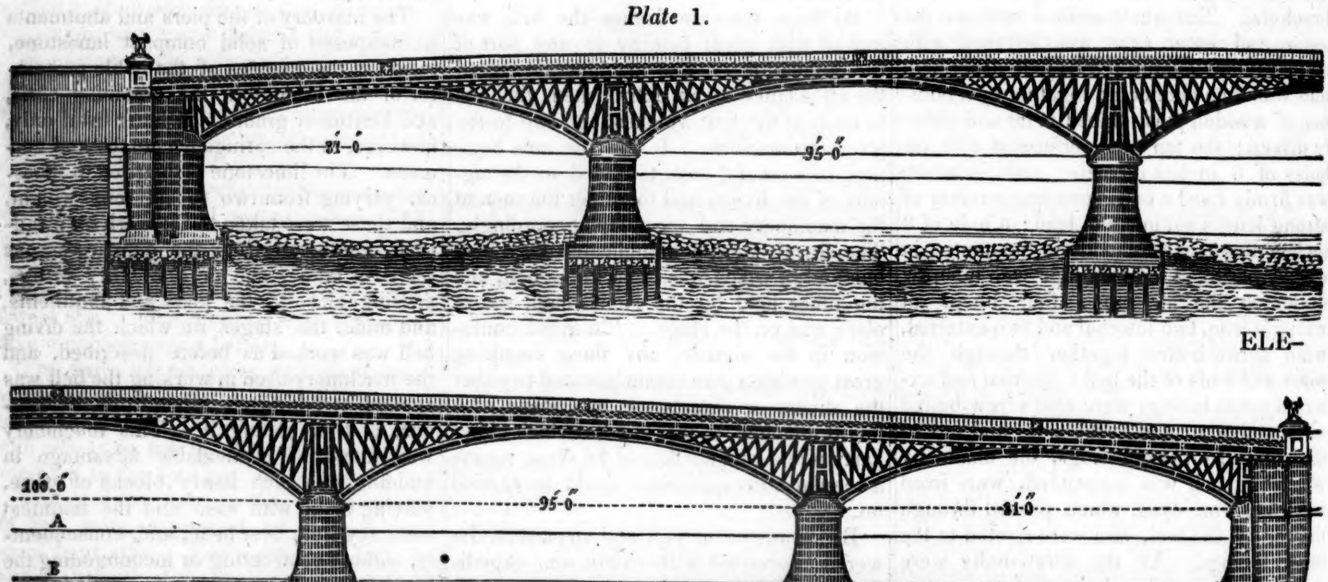
The work commenced in August, 1824, and the Bridge was opened in July, 1827.

* At the present time (1836) the surface is so hard, that heavily laden wagons would not sink in it.

CAST IRON BRIDGE OVER THE LARY, NEAR PLYMOUTH.

By JAMES M. RENDEL, Civil Engineer.

Plate 1.



ELEVATION.

A, High water Spring Tides. B, Low water Spring Tides.

Plan of the Roadway.

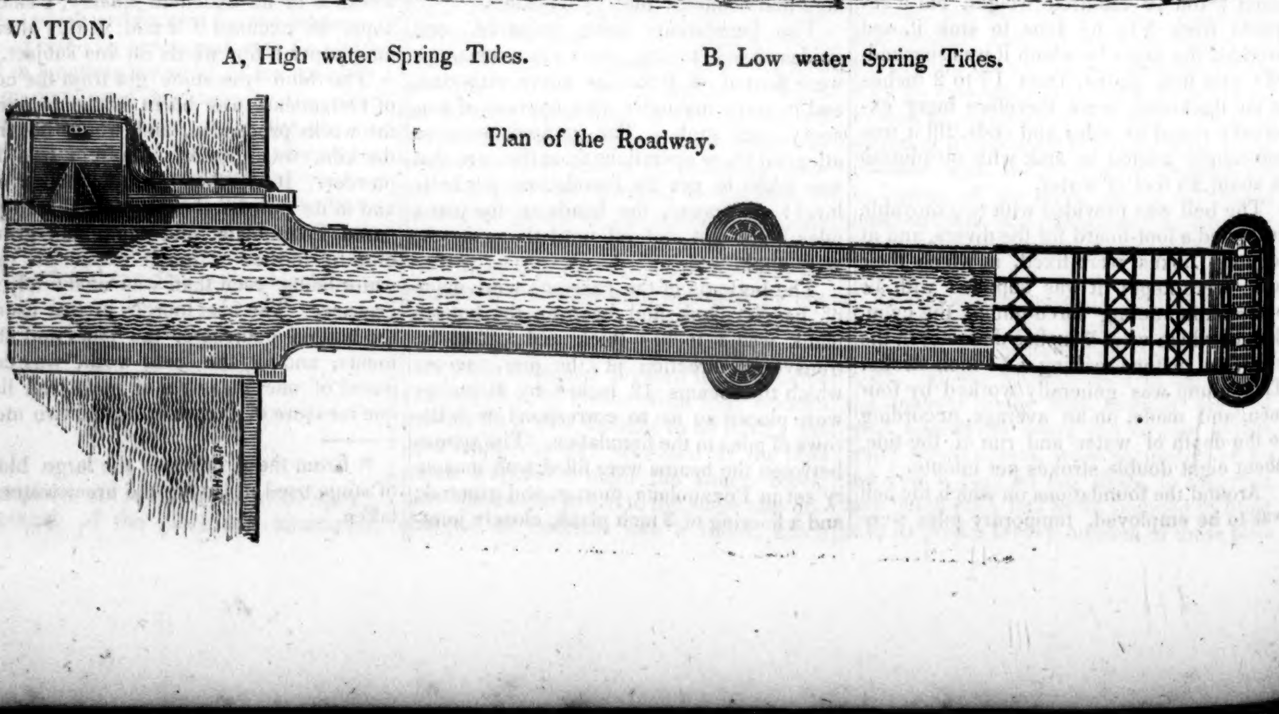
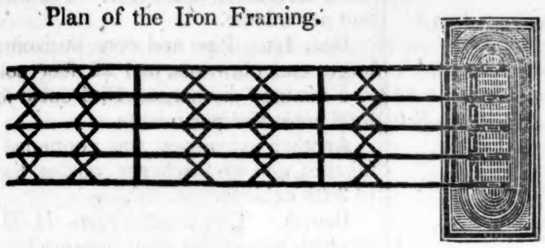


Plate 1.

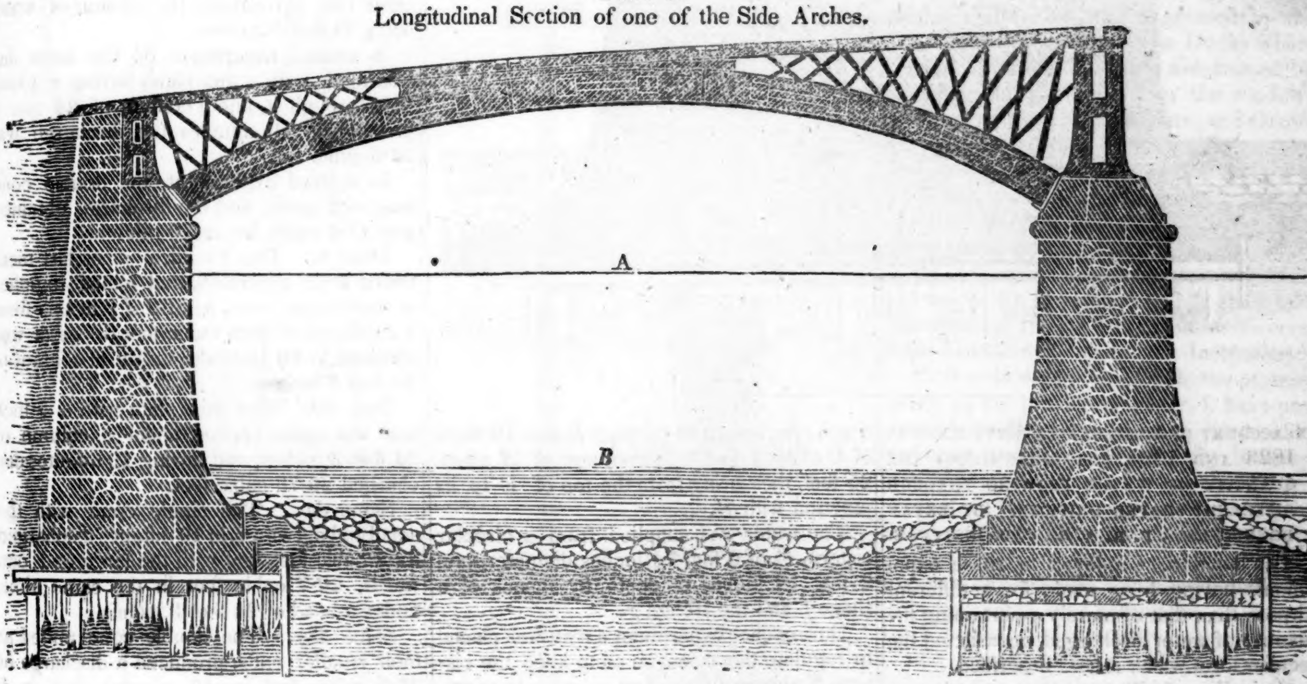
Plan of the Iron Framing.



Plan of the Foundation.

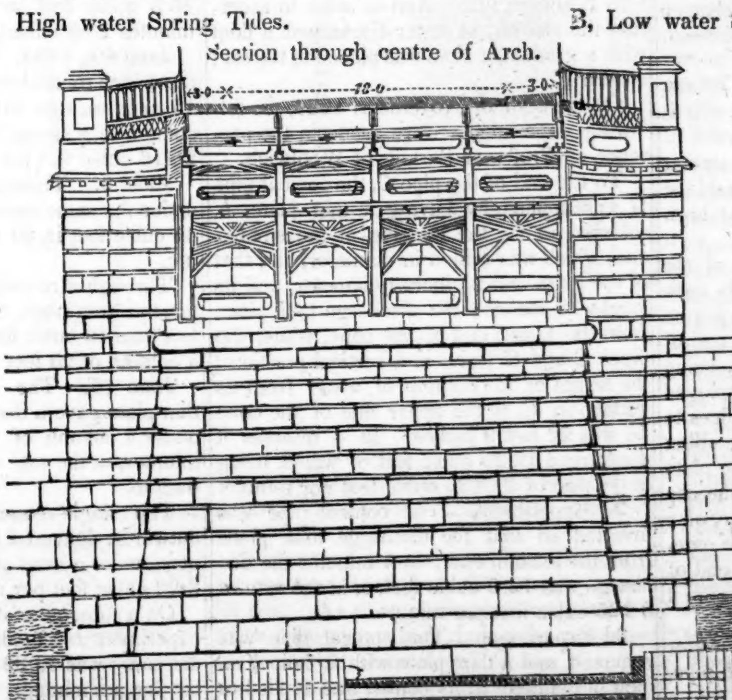
Plate 2.

Longitudinal Section of one of the Side Arches.

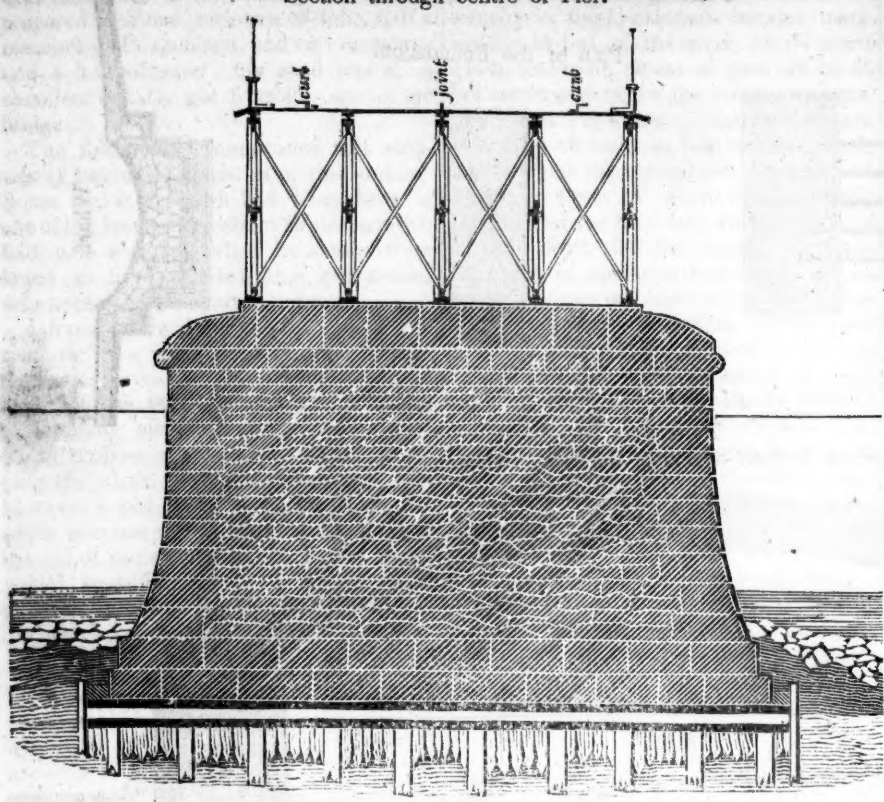


A, High water Spring Tides. B, Low water Spring Tides.

Section through centre of Arch.



Section through centre of Pier.



AN ACCOUNT OF SOME EXPERIMENTS MADE IN 1823 AND 1824, FOR DETERMINING THE QUANTITY OF WATER FLOWING THROUGH DIFFERENT SHAPED ORIFICES. BY BRYAN DONKIN, ESQ., F. R. A. S., V. P. INST. C. E.

The apparatus employed in these experiments having been made for a different purpose than that of merely ascertaining the quantity of water discharged, occasioned the peculiar form which is here described.

A, in Fig. 1, Plate ——., represents a vertical copper pipe of 3⅜ inches interior diameter.

B, a horizontal pipe of the same diameter, joined to the lower end of *A* by what is usually called a mitre joint.

C, another pipe, joined to *B* in a similar manner, but so contrived that it could be turned up or down into a vertical or horizontal position.

Fig. 2 represents the outer end of the pipe *C*, with a cap, *D D*, fitting closely upon its outer side, and capable of being put on or taken off at pleasure; upon the end of cap *D* the ring *d d* was soldered, being about ¼ inch wide; this cap was employed for securing the different shaped orifices to the pipe *C*. For instance, where the efflux of water through an aperture in a thin plate of metal was intended to be tried, the cap was taken off, and a circular plate *e e*, of a corresponding diameter to that of the exterior of the tube *C*, was applied to the end of *C*, and the cap *D D* put over it to secure it in its place.

To guard against any leakage of water between the joinings of the cap, the pipe, and the plate, the joinings were filled with a soft cement made of tallow and bees' wax.

Upon the upper end of the pipe *A*, a copper cistern, *E*, was fixed. This cistern was about 2 feet diameter and 6 or 7 inches in depth; the length of the pipe *B* was 10 feet; of *C* about 1 foot 9 inches, and of *A* about 25 feet, measuring from the top of *E* to its junction with *B*.

The water was supplied from a circular cistern, *F*, of 6 feet 7½ inches diameter, and 2 feet 10 inches in depth, by means of a sluice *f*, and the trough *g*.

During each experiment a man was placed to regulate the sluice, so as to keep the cistern *E* always full. And in order to ascertain the quantity of water discharged, a float with a graduated stem was placed in the said cistern *F*.

On the 28th of November, 1823, the following experiments were made in the presence of Professor Barlow, of Woolwich.

To the end of the pipe *C*, the conical pipe *G* was applied, by having a thin plate, *h*, soldered to it; the opening at the smaller end, which was ½ inch in diameter, and that of the large end 2½ inches diameter, and its length 12 inches; the discharge took place from the larger end of the cone, whilst the pipes *C* and *G* were in a vertical position; the height of the column of water from its surface in *E*, to the upper end of the cone *G*, was 22 feet 9 inches. In 4 minutes it discharged 12·25 cubic feet of water, being at the rate of 3·0625 cubic feet per minute.

2d Experiment.—The conical pipe was inverted so that the discharge took place from the smaller end; in 4 minutes the discharge was 12·5 cubic feet, or at the rate of 3·125 cubic feet per minute.

3d Experiment.—The conical pipe was removed, and a thin plate with a hole ½ an inch in diameter in its centre was applied to the end of the pipe *C*, the height of the column being 23 feet 3 inches; in 4 minutes the discharge was 8·2 cubic feet, or at the rate of 2·05 cubic feet per minute.

Nov. 29. The pipe *C* and the cone *G* were placed horizontally, with the smaller end of the cone outwards, and a column of 26 feet; in 8 minutes it discharged 26·8 cubic feet, being at the rate of 3·35 cubic feet per minute.

Dec. 1st. Pipe and cone horizontal, the larger end outwards, and 26 feet column; in 5 minutes discharged 15·4 cubic feet, or 3·08 cubic feet per minute.

Another experiment was continued for 8 minutes, and the discharge was at the rate of 3·09 cubic feet per minute.

Dec. 5. Two conical pipes, *H H*, each of which was of the same dimensions as the one above described, were united at their smaller ends, and applied to the pipe *C*; in 10 minutes the discharge through the double cone was 48 cubic feet, or at the rate of 4·8 cubic feet per minute, the column of water being 24 feet 3 inches.

A second experiment on the same day was made with a thin plate, having a ½ inch hole through it, and a column of 24 feet 3 inches; in 10 minutes the discharge was 20·6 cubic feet.

In a third experiment, the double cone was tried again, and the discharge obtained was 47·4 cubic feet in 10 minutes.

Dec. 8. The 2 conical pipes last mentioned were separated, and joined together at their larger ends, as at *J J*; in this form a discharge of 20·8 cubic feet of water was obtained in 10 minutes, under a column of 24 feet 3 inches.

Dec. 12. The thin plate with a ½ inch hole was again applied under a column of 24 feet 3 inches, and during 10 minutes discharged 20·75 cubic feet.

Same day. The single cone with the small end outwards, in 10 minutes discharged 32·2 cubic feet, and with the large end outwards, 29·7 cubic feet in the same time, under a head of 24 feet 3 inches.

Same day. The double cone united at their smaller ends, produced a discharge of 46·5 cubic feet in 10 minutes, and in 5 minutes 23·5 cubic feet.

June 8th, 1824. The discharge through the ½ inch round hole in the thin plate during 15 minutes, was 31·75 cubic feet, under a column of water of 24 feet 4 inches high = 2·116 cubic feet per minute.

June 9. Through the same hole, and under the same column, the discharge was 42 cubic feet in 20 minutes;=2·1 per minute.

Through a round hole ¼ of an inch diameter, in a thin plate, the discharge was rather less than 16 cubic feet in 30 minutes, under a column of 25 feet 8½ inches.

June 10. The ½ inch hole through a thin plate gave a discharge of 65 cubic feet under a column of 25 feet 8½ inches in 30 minutes, at the rate of 2·166 cubic feet per minute.

The single cone, with the smaller enp outwards, delivered 58 cubic feet in 18 minutes, under a head of 25 feet 8½ inches;= 3·22 cubic feet per minute.

On a subsequent day in June. The same experiment repeated, and in 20 minutes the discharge was 63·33 cubic feet;=3·166 cubic feet per minute. In this experiment, the small end of the cone was immersed about 6 inches below the surface of the water during the discharge, consequently the column was 25 feet 2½ inches.

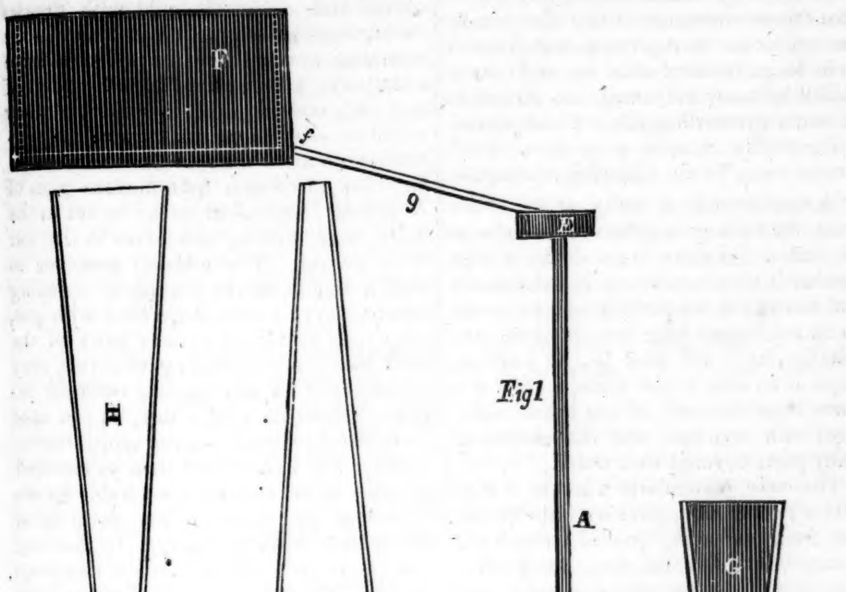
Another experiment on the same day,

with the same cone, having its larger end outwards, and immersed seven inches below the surface of the water, discharged 59 cubic feet of water in 20 minutes ;=2·95 cubic feet per minute.

The same experiment repeated during 10 minutes, gave a discharge of 29·46 cubic feet, or 2·946 cubic feet per minute.

In another experiment, the double cone joined at the smaller ends, in 18 minutes discharged 84·633 cubic feet under a head of 25 feet 9 inches ;=4·7 cubic feet per minute.

Another experiment. The same double cone with its axis 7 inches under water, and a column of 25 feet 2 inches, discharged 56·5 cubic feet in 12 minutes ;=4·7 cubic feet per minute.



ON VENTILATING AND LIGHTING TUNNELS, PARTICULARLY IN REFERENCE TO THE ONE ON THE LEEDS AND SELBY RAILWAY. BY J. WALKER, ESQ., F. R. S. L. AND E., PRESIDENT INST. C. E.

The want of ventilation and light seems the greatest objection to tunnels on railways and canals. An attempt is making to remedy both these evils in the tunnel now (1832) forming on the Leeds and Selby Railway, near Leeds, by a plan weich is simple, not attended with much expense, and likely to be at least partially successful. A short description will suffice to make it understood.

The tunnel is nearly half a mile long; the greatest depth from the surface about 80 feet. As three shafts were required for raising the excavation during the progress of the work, it occurred to me, that by placing them at nearly equal distances, and walling them in a permanent manner, they might be left open to the surface afterwards. A strong elliptical casting, about 8 feet long and 5 feet wide, has therefore been built in the arch of the tunnel, and over this a circular shaft or well, 10 feet diameter, raised in strong brickwork. If it be found expedent to cover the well as a protection from the rain, it may be done with glass, raised on columns of such height as to admit a free circulation of air between the surface of the ground and the roof.

So much for ventilation. But as the light afforded by the shafts is confined to the space immediately below them, the desideratum is to throw it along the tunnel, and I think this may be done so as to give a useful light by means of plane reflectors of tinned iron placed on the ground between the two lines of railway, at such an angle as to reflect the light where it will be most useful. The idea was suggested by the rum vaults in the West India Docks where the marks on the casks are ascertained by catching the taint light from the windows upon a small piece of tin plate, and throwing it on the casks. Those who have seen this done have generally been surprised at the useful effect produced; but in the case of the tunnel, the light coming directly down the shaft is more powerful, and the effect of the experiments I have made has much exceeded my expectations. I shall take care that the results of any future observations be communicated to the Institution.

P. S.—In compliance with the promise given in the preceding paper, I have procured from Mr. George Smith, the resident engineer on the Leeds and Selby Railway, the annexed observations on the subject containing the result of his recent experience. Though they do not in all respects realize the expectations I had formed from the first experiments which were made before the tunnel was completed, or the railway formed, I may remark, that while the shafts seem to be very serviceable for ventilation, the light they supply is useful to those whose duties require them to pass through the tunnel on foot or unaccompanied with an engine. Mr. Smith's remarks are dated December 1835, and are as follows :—

"At the present period when there are "so many railways in progress and in contemplation, many of them with tunnels of "considerable length, the following observations on the effects of the Locomotive "Engines, working in the tunnel of the "Leeds and Selby Railway, may be interesting to those who have not the opportunity of witnessing those effects daily "and under all circumstances.

"The tunnel of the Leeds and Selby "Railway is nearly half a mile in length, "situated at the commencement of that railway at the Leeds end, and has a slight "ascending inclination in going from Leeds. "The situation and inclination cause a considerable difference in the quantity of "steam discharged from the chimneys of "two engines travelling in opposite directions.

"The ascending engine laboring at a "first start against the inclination, to get "into speed, (which is scarcely done before leaving the tunnel,) causes a great "expenditure of steam, &c., while an en-

"gine coming in the opposite direction, "having a clear fire, and every means taken "to prevent the generation of steam, by "opening the fire-door and pumping water "into the boiler, expends very little, and "that through the safety valve, the smoke "from the chimney not being perceptible. "It will therefore be necessary to detail the "effect of an engine passing through the "tunnel from the Leeds end only.

"The fires of the engines are made up, "previous to starting, with coke mixed "with coal, to hasten the ignition of the "former; the smoke from the coal is of "course mixed with that of the coke and "steam, adding to the density of what es- "capes from the chimney, and continues "to do so for some time, frequently through "the whole length of the tunnel; but not- "withstanding this, the tunnel is generally "clear in less than five minutes after; in "many cases nearly as soon as the engine "has left it. This of course is governed, "in a great measure, by the force and di- "rection of the wind. In foggy weather "there being little or no wind, the smoke "from the coal is left after the steam is "condensed, and forms itself into a cloud "which sails slowly along the roof, travel- "ling at the rate of from two to three miles "per hour; a great part of it ascends the "shafts, but from the heavy state of the "atmosphere, a considerable portion passes "them and discharges itself at one end of "the tunnel. It should here be mentioned, "that the entrances into the shaft from the "tunnel are much contracted, having not "more than 5 feet in the longitudinal, and "8 feet in the transverse direction of the "tunnel, and much of the smoke, &c., "passes on each side of the shafts; and in "consequence of the sluggishness of the "draught on those days, the lower part of "the cloud has not sufficient time to alter "its course up the shafts.*

"The engines, having coal mixed with "the coke in their fire-boxes, left the Leeds "depot during a very heavy morning, and "followed each other quickly through the "tunnel: each left a cloud behind, the one "keeping at a considerable distance from "the other. The smoke (the steam ap- "pearing to have been condensed) seemed "to have lost its usual sulphurous smell, "and resembled a dense fog—the dense- "ness appearing greater from the darkness "of the tunnel; and such is the freedom "of those clouds from any thing unpleasant, "that passengers in close carriages are not "aware of having passed through them, "which they do almost instantaneously.

"Passengers are never annoyed with the "steam, &c., from the chimneys of the "engines, as it does not descend low "enough, except on heavy days, and even "then, the progress of the engines carries "them forward before it is so low as to "affect them.

"From the effects described above, it "appears evident, that in tunnels situated "only a short distance from the starting- "place, it is extremely probable little or no "inconvenience will be felt by the passen- "gers passing through them.

"Previous to the opening of the Leeds "and Selby Railway, great doubts were "entertained by many, and among others "a celebrated lecturer, as to the fitness of "the atmosphere for respiration, in a tun- "nel worked by locomotive engines; now "that the incorrectness of that idea is fully "proved, as far as regards a tunnel half a "mile long, those doubts are still enter- "tained by many individuals, as to tunnels "of much greater lengths. These doubts "will probably prove as groundless as the "former ones, for the following reasons:—

"A considerable quantity of the steam "from the engines ascends the shafts at "all times, but there is no doubt a large "portion is also condensed in the tunnel; "and were there no shafts at all, the steam "could not remain long uncondensed, sur- "rounded, as it will ever be, by walls al- "ways at an even temperature, a short dis- "tance from the ends of the tunnel, satu- "rated with moisture, and the surface in "many parts covered with water.

"The coke, particularly when in a high "state of combustion, gives out little smoke, "and, from its having passed through the "steam, loses, like the coal, the greater "part, if not all its offensiveness; and "mixing with the air that has been used "for combustion, will, from its boyancy, "readily find its way along the top of the "tunnel to the first shaft, and make its "escape up it.

"Two great inconveniences in tunnels, "are noise and want of light; the former "it will be difficult to remedy, the latter "may be easily so, by carrying oil or porta- "ble gas lamps with the carriages. Oil "lamps are used with the evening trains, "during the winter months, on the Leeds "and Selby Railway, and give sufficient "light in their passage through the tunnel. "Some experiments were made with tin "reflectors at the bottom of the shafts, and "although the light reflected was sufficient "to read the larger print in a newspaper "advertisement at all parts of the tunnel, "(there being three shafts,) it is very doubt- "ful whether lighting tunnels by reflection "will be of use for passengers. The rays "of light are thrown on the walls so very "obliquely, that, from the rough and dirty "state of their surface, few are again re- "flected from them, and these are too "feeble for the eye to accommodate itself "to so great a transition during the time a "train would be passing through a tunnel "of moderate length. A passenger sitting "in a close carriage, having only the walls "to look at, would, under such circum- "stances, fancy himself in total darkness, "although the tunnel generally might be "moderately light. The difficulty of keep- "ing reflectors clean from the effects of "damp, steam, &c., would be a considera- "ble expense in a long tunnel; and it must "also be borne in mind, that the moment "an engine has passed a reflector, it be- "comes of no use to the train attached to "that engine, as it is immediately sur- "rounded with steam, &c., forcing its way "up the shaft, and the next reflector, in a "long tunnel, would probably be a quarter "of a mile from the one thus thrown into "darkness."

* This naturally suggests the propriety of having the shafts much larger, probably the same diameter as the width of the tunnel.

Aeronautic Observations.—Mr. Green, who recently ascended in a balloon with Lord Clanricarde, observed that surveyors and architects could with greater facility take plans of noblemen's estates by ascending in a balloon, as they could have a bird's-eye view of every locality, and if they only once adopted that method they would never relinquish it. Since the suggestion, an artist named Burton called on Mr. Green to obtain from him the plan of a balloon constructed so as to act in the above way, it being connected to the car by a swivel. The inventor proposes to build a wagon, for the purpose of fastening a balloon to it, which, when filled with gas, which can be done in various parts of the country at gas company's gasometers, may be conveyed to any place a surveyor requires, where, on a calm day, he can take plans, carrying with him the proper instruments. The balloon will then be fastened by ropes to the spot most favorable for observations, and raised to an elevation of 300 or 400 feet, as necessary. In this way a bird's-eye view can be taken of any town or city. Mr Green is willing at any time that his balloon, by way of experiment, may be made use of in that way.—[Lond. Mech. Mag.]

Steam Carriages on Common Roads. —A committee of the British House of Lords have, by their report to the House, objected to the reduction of prohibitory tolls on such carriages; on the ground of the danger in frightening horses, of setting fire to buildings, &c., of the greater skill required to manage such locomotives than those on railways; and more especially from the opinion that such enterprises cannot become profitable to those who engage in them, and that, therefore, any encouragement on the part of the Legislature would only give rise to wild speculations, ruinous to those who pursue them. G.

New Surveying Instruments.—M. Lalanne, Engineer of the *Ponts et Chaussees*, in France, has laid before the *Academie des Sciences* three instruments for typographical surveying, which, if they accomplish all that the inventor promises, correctly and with facility, will be eagerly sought after. To the immense number of surveyors, who are about to commence operations in every part of the United Kingdom, under the numerous Railroad Acts which have passed this session, such instruments would be invaluable. They are, 1st, a Levelling Instrument, or Carriage, which it is only necessary to run over the ground, the levels of which are desired, and the section is at once obtained; 2nd, a Drawing Instrument, which lays down the plan of the ground; and can be mounted on the carriage of the Levelling Instrument; 3rd, a Power-measuring In-

strument, or Dynamometer, which exhibits the effort exerted on every point of the line passed over.—[Mag. Pop. Science.]

Copper Ore raised in Cornwall.—The quantity of copper ore raised at about eighty mines in the county of Cornwall, during the past twelve months, was 140, 931 tons of 21 cwts., the average produce of which was 8¼, giving 11,639 tons 11 cwt. of copper; the average price for the ore was £6,17 per ton, amounting to £957-752,86. With three or four exceptions not one of these mines belong to a public company.

Mining in Cornwall.—The steam engines now at work in the mines of Cornwall, are equal in power to at least 44,000 horses. One bushel of coal does as much work as sixteen bushels did in the earlier stages of the employment of steam power.—[Newton's Jour.]

List of subscribers to the **Railroad Journal.** that have paid, (continued.)

J. U. Coles, city of New-York, Jan. 1, 1838
S. Gregory, " " " 1, 1838
H. H. Farnham, Honesdale, Pa., Jan. 1, 1838
J. Jessup, York, Pa., Jan. 1, 1838
H. M. Walker, Philadelphia, Pa., 2d copy, Jan. 1, 1838
Col. J. G. Totten, Newport, R. I., July 1, 1837
D. Livermore, Hopkinsville, Ky., Jan. 1, 1838
G. Dutton, Columbus, Ohio, Jan. 1, 1838
S. Appleton, Boston, Mass., April 1, 1837
Bacon & Kibby, Brownstown, Mich., Jan. 1, 1838
J. M. Bucklin, Terre Haute Ind., Jan. 1, 1838
Jas. Collins, Brooklyn, L. I., Oct. 1, 1837

Advertisements.

☞ **Missing Numbers Wanted.**—If any of our subscribers have numbers 4, 5, 6 and 7, of Volume or *five last* year, which they do not desire to preserve, they will confer a special favor by sending them to us, that we may complete a few copies of the volume.

⁂ If any of our subscribers are in want of *any other* number of the same volume to complete their volume they will please give early notice and they shall be sent.

The Title page and Index for last year, or volume five, will be forwarded to subscribers with our next number.

AVERY'S ROTARY STEAM ENGINES.—AGENCY.—The subscriber offers his services to gentlemen desirous of procuring Steam Engines for driving Saw-Mills, Grain-Mills, and other Manufactories of any kind.

Engines only will be furnished, or accompanied with *Boilers* and the necessary *Machinery* for putting them in operation, and an Engineer always sent to put them up.

Information will be given at all times to those who desire it, either by letter or by exhibiting the engines in operation in this city.

Inquiries by letter should be very explicit and the answers shall be equally so.

D. K. MINOR,
30 Wall-st., New York.

RAPPAHANNOCK CANAL & SLACK WATER NAVIGATION.

NOTICE TO CONTRACTORS.

SEALED Proposals will be received until the 7th day of April next, by the subscriber, on behalf of the Rappahannock Company, at the office of their Engineer, in the Town of Fredericksburg, for the construction of four new dams, raising, covering and backing several others, several short canals, 14 new lift locks, of wood and stone combined, 10 guard locks, and other incidental works, for that portion of the Slack Water Navigation extending from the town of Fredericksburg to Barnett's Mills, a distance of 20 miles.

The prices for the work must include the expense of materials necessary for the completion of the same, according to plans and specifications that will be ready for examination on the 1st to the 7th April, inclusive.

The works to be completed by the 15th day of November of the present year.

It is believed that the work above offered for contract presents superior inducements, especially to such as have been accustomed to, and prefer contracts embracing heavy dry walling and carpentry, the materials of which are at hand and in abundance.

No fears need be entertained as to the healthfulness of the climate. The usual testimonials of character and responsibility will be expected to accompany the proposals.

P. MARTINEAU, Chief Eng.
March 18, 1337. 12—3t

WABASH AND ERIE CANAL.

NOTICE TO CONTRACTORS.—Sealed proposal will be received at the town of MAUMEE, in Lucas county, Ohio, *on the 15th day of May next*, for the construction of so much of the line of the Wabash and Erie Canal as lies between the head of the rapids of the Maumee River and the eastern termination of said canal, near the town of Mahatten, at the head of the Maumee Bay.

The length of the line offered for contract is about thirty miles, and embraces a large amount of embankment, much heavy river bluff excavation, a quantity of rock, a number of stone culverts, and 12 to 15 cut stone locks.

Thirty miles of the line, in addition to the above extending from the head of the rapids to the town of Defiance, will also be prepared, and offered for contract at the same time, should the number of applicants for contracts justify it.

Plans and specifications will be exhibited, and necessary information given, in relation to the work, after the tenth of May.

Bidders who are unknown to the acting Commissioner, as contractors, will be expected to accompany their proposals with recommendations of a substantial and unquestionable character.

LEANDER RANSOM.
Acting Commissioner
Office of the Board of Public Works, Columbus, Ohio, Feb. 28, 1837,
13—2t

TRANSACTIONS OF THE INSTITUTION OF CIVIL ENGINEERS OF GREAT BRITAIN.

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